Register No.: ……………………………… Name: ……………………………………………………….

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (Regular), JULY 2022

GEOMECHANICS AND STRUCTURES

(2021 Scheme)

Course Code: **21GS203**

Course Name: **Dynamics of Soil and Design of Machine Foundations**

Max. Marks: **60** **Duration: 3 Hours**

Use of IS:2974(Part I) and IS: 2974 (Part II) are permitted

PART A

(Answer all questions. Each question carries 3 marks)

1. Explain frequency dependent exciting force. Also write the expression for amplitude and phase angle.
2. Explain elastic half space theory.
3. What are the special considerations in the design of machine foundations?
4. How will you calculate unbalanced forces and moments in a single cylinder reciprocating type machine?
5. Sketch a typical hammer foundation and explain the important components.
6. How will you find the dynamic stresses on elastic pad and soil?
7. Describe different isolation materials.
8. Explain force transmissibility and motion transmissibility.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Obtain the frequency equation for a two-degree freedom system executing undamped free vibration. (6)

OR

10. A mass of 1kg is to be supported on a spring having a stiffness of 980 N/m. The damping coefficient is 6.26 N-s/m. Determine the natural frequency of the system. Find also the logarithmic decrement and the amplitude after three cycles if the initial displacement is 0.3mm. (6)

MODULE II

11. A cyclic plate load test was carried out on a deposit of silty sand to estimate the elastic coefficients for the design of a compressor foundation. The test was carried out at a depth of 3 m using a 30 cm x 30 cm test plate. The data obtained are; (6)

Load intensity kN/m²	25	0	50	0	75	0	100	0	150	0	200	0	250	0
Settlement (mm)	0.5	0.4	0.95	0.8	1.6	1.25	2.5	1.9	3.6	2.6	4.8	3.8	6.7	4.9

Plot stress vs elastic settlement and find C_u, C_τ, C_ϕ and C_φ.

OR

12. Describe the methods for determination of damping factor. (6)

MODULE III

13. Starting from fundamentals, derive the expression for natural frequencies and amplitudes of a block foundation subjected to a vertical force, $P_z \sin\omega t$ horizontal force, $P_x \sin\omega t$ and a moment, $M_y \sin\omega t$ at the combined centre of gravity of machine foundation. (6)

OR

14. A reciprocating machine is symmetrically mounted on a block of size 4 x 3 x 3.5m high. The soil at the site is sandy in nature having a depth of 3m below the ground surface. The block is embedded in the ground surface by 2m depth. The machine is small in comparison to the weight of foundation. The machine is vibrating at speed of 250rpm generates

Max. vertical unbalanced force=2.5kN
Torque about Z-axis =4 kN
Max. horizontal unbalanced force=2kN at a height of 2 m above the block (6)
Limiting amplitude of the machine=150 microns
Unit weight of concrete=24kN/m^3
C_u=4.5x10^4 kN/m^3
G=1.1x10^4 kN/m^2
E=2.4x10^4 kN/m^2
μ=0.35
Determine the natural frequencies of the block by weightless spring method.

MODULE IV

15. Calculate the unbalanced inertial forces for a two-cylinder vertical compressor with the following data;

(i) Operating speed =650 rpm
(ii) Equivalent weight concentrated at the crankpin of each cylinder=45N
(iii) Equivalent weight concentrated at the head of the compressor=250N (6)
(iv) Radius of the crank =430mm
(v) Crank angles
(a) $\alpha_1=0$, $\alpha_2=\pi/2$
(b) $\alpha_1=0$, $\alpha_2=\pi$

OR

16. Explain the single crank mechanism of a reciprocating type machine with a neat sketch. Also give expression for unbalanced forces and moments in a two-cylinder (6)

engine.

MODULE V

17. A forging hammer, weighing 20 kN has the following specifications:
Weight of tup without die = 12 kN, Maximum tup stroke = 900 mm
Weight of upper half of die = 5 kN, Area of piston = 0.15 m^2
Steam pressure = 700 kN/m^2, Weight of anvil block = 400 kN
Total weight of anvil and frame = 500 kN, Base area of anvil = 2.1m x 2.1m,
Permissible amplitude for anvil=1.5 mm, (6)
Permissible amplitude for foundation=1.2mm
It is proposed to use a pine wood pad of thickness 0.5m below the anvil. The modulus of elasticity of pad material is 6 x 10^5 kN/m^2 and the allowable stress in the pad is 4,000 kN/m^2. C_u = 2.6 x 10^4 kN/m^3. The soil at the site is sandy in nature and allowable soil pressure is 250 kN/m^2. Design a suitable foundation.

OR

18. Explain IS code method for design of hammer foundations. (6)

MODULE VI

19. A machine of mass 100 kg is suspended on springs of total stiffness of 784 N/mm. The machine produces an unbalanced disturbing force of 392 N at a speed of 50cps. Assuming a damping factor of 0.2, determine; (6)
(i)The amplitude of motion due to unbalance
(ii)The transmissibility
(iii)Transmitted force

OR

20. Explain different methods of vibration isolation. (6)

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